

Hypergravity in AdS_3

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Abstract

Thirty years ago Aragone and Deser showed that in three dimensions there exists a consistent model describing interaction for massless spin-2 and spin- $5/2$ fields. It was crucial that these fields lived in a flat Minkowski space and as a result it was not possible to deform such model into anti-de Sitter space. In this short note we show that such deformation becomes possible provided one compliment to the model with massless spin-4 field. Resulting theory can be considered as a Chern-Simons one with a well-known supergroup $OSp(1,4)$. Moreover, there exists a straightforward generalization to the $OSp(1,2n)$ case containing a number of bosonic fields with even spins $2, 4, \dots, 2n$ and one fermionic field with spin $n + 1/2$.

1. Introduction

Thirty years ago Aragone and Deser showed [1] that in three dimensions there exists a consistent model describing interaction for massless spin-2 and spin- $\frac{5}{2}$ fields. It was crucial that these fields lived in a flat Minkowski space and as a result it was not possible to deform such model into anti-de Sitter space. Taking into account crucial role that AdS background plays in all massless higher spin theories it is natural to look for generalization of such model admitting deformation into AdS space. In this note we show that such deformation becomes possible provided one compliment to a model with massless spin-4 field. Resulting theory can be considered as a Chern-Simons one with a well-known supergroup $OSp(1,4)$. Moreover, there exists a straightforward generalization to the $OSp(1,2n)$ case containing a number of bosonic fields with even spins $2, 4, \dots, 2n$ and one fermionic field with spin $n + 1/2$.

The paper is organized as follows. In Section 2 in our current formalism (see notations and conventions below) we reproduce the well-known fact (see e.g. [2]) that three-dimensional gravity in AdS background can be considered as a Chern-Simons theory with group $SO(2,1) \otimes SO(2,1)$. Then in Section 3 we start directly with the Chern-Simons theory with $OSp(1,2)$ supergroup and show that in AdS background it corresponds to minimal $(1,0)$ supergravity (for the general case of extended (M,N) supergravities, see [3]). At last, in Section 4 we consider straightforward generalization of such supergravity model to the well-known $OSp(1,4)$ supergroup and show that in AdS background it describes interacting system of massless spin-2, spin-4 and spin- $\frac{5}{2}$ fields.

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Notations and conventions We will use a multispinor frame-like formalism where all gauge fields are one-forms but with all local indices replaced with the completely symmetric spinor ones. Spinor indices $\alpha, \beta = 1, 2$ will be raised and lowered with $\varepsilon^{\alpha\beta} = -\varepsilon^{\beta\alpha}$ such that $\varepsilon^{\alpha\beta}\varepsilon_{\beta\gamma} = -\delta^\alpha_\gamma$. For the AdS_3 background we will use background frame $e^{\alpha\beta} = e^{\beta\alpha}$ and AdS_3 covariant derivative D normalized so that

$$D \wedge D\xi^\alpha = \frac{\lambda^2}{4} e^\alpha_\gamma \wedge e^{\beta\gamma} \xi_\beta$$

In what follows we will not write the symbol \wedge explicitly.

2. Gravity in AdS_3

In this section we consider frame formulation of gravity in AdS_3 background. We need two one-forms $h^{\alpha\beta}$ and $\omega^{\alpha\beta}$ which are symmetric bi-spinors. The Lagrangian (being three-form) looks like:

$$\begin{aligned} \mathcal{L} = & \omega_{\alpha\beta} e^\alpha_\gamma \omega^{\beta\gamma} + \omega_{\alpha\beta} D h^{\alpha\beta} + \frac{\lambda^2}{4} h_{\alpha\beta} e^\alpha_\gamma h^{\beta\gamma} \\ & + a_0 h_\alpha{}^\beta \omega_\beta{}^\gamma \omega_\gamma{}^\alpha + \frac{a_0 \lambda^2}{12} h_\alpha{}^\beta h_\beta{}^\gamma h_\gamma{}^\alpha \end{aligned} \quad (1)$$

where a_0 is a coupling constant. This Lagrangian is invariant under the following local gauge transformations:

$$\begin{aligned} \delta \omega^{\alpha\beta} &= D \eta^{\alpha\beta} + \frac{\lambda^2}{4} e^{(\alpha}_\gamma \xi^{\beta)\gamma} \\ &\quad + a_0 \omega^{(\alpha}_\gamma \eta^{\beta)\gamma} + \frac{a_0 \lambda^2}{4} h^{(\alpha}_\gamma \xi^{\beta)\gamma} \\ \delta h^{\alpha\beta} &= D \xi^{\alpha\beta} + e^{(\alpha}_\gamma \eta^{\beta)\gamma} \\ &\quad + a_0 \omega^{(\alpha}_\gamma \xi^{\beta)\gamma} + a_0 h^{(\alpha}_\gamma \eta^{\beta)\gamma} \end{aligned} \quad (2)$$

Now let us introduce new variables:

$$\hat{\omega}^{\alpha\beta} = \omega^{\alpha\beta} + \frac{\lambda}{2} h^{\alpha\beta}, \quad \hat{h}^{\alpha\beta} = \omega^{\alpha\beta} - \frac{\lambda}{2} h^{\alpha\beta} \quad (3)$$

and similarly for the parameters of gauge transformations:

$$\hat{\eta}^{\alpha\beta} = \eta^{\alpha\beta} + \frac{\lambda}{2} \xi^{\alpha\beta}, \quad \hat{\xi}^{\alpha\beta} = \xi^{\alpha\beta} - \frac{\lambda}{2} \eta^{\alpha\beta} \quad (4)$$

In terms of these variables the Lagrangian becomes a sum of two independent Lagrangians for $\hat{\omega}$ and \hat{h} fields, each one having its own gauge symmetry. In what follows we restrict ourselves with one field $\hat{\omega}$ only. Corresponding Lagrangian has the form:

$$\mathcal{L} = \frac{1}{2} \hat{\omega}_{\alpha\beta} D \hat{\omega}^{\alpha\beta} + \frac{\lambda}{2} \hat{\omega}_{\alpha\beta} e^\alpha_\gamma \hat{\omega}^{\beta\gamma} + \frac{a_0}{3} \hat{\omega}_\alpha{}^\beta \hat{\omega}_\beta{}^\gamma \hat{\omega}_\gamma{}^\alpha \quad (5)$$

and is invariant under the following gauge transformation:

$$\delta\hat{\omega}^{\alpha\beta} = D\hat{\eta}^{\alpha\beta} + \frac{\lambda}{2}e^{(\alpha}{}_{\gamma}\hat{\eta}^{\beta)\gamma} + a_0\hat{\omega}^{(\alpha}{}_{\gamma}\hat{\eta}^{\beta)\gamma} \quad (6)$$

Now let us introduce convenient combination

$$\hat{\omega}_0^{\alpha\beta} = \omega_0^{\alpha\beta} + \frac{\lambda}{2}e^{\alpha\beta} \quad (7)$$

where $\omega_0^{\alpha\beta}$ is an AdS_3 background Lorentz connection, so that

$$d\hat{\omega}_0^{\alpha\beta} + \hat{\omega}_0^{\alpha}{}_{\gamma}\hat{\omega}_0^{\beta\gamma} = 0 \quad (8)$$

Here and in what follows d is a usual external derivative $d^2 = 0$. Then introducing new variable

$$\Omega^{\alpha\beta} = \frac{1}{a_0}\hat{\omega}_0^{\alpha\beta} + \hat{\omega}^{\alpha\beta}$$

the Lagrangian, gauge transformations and equations can be rewritten in a very simple form:

$$\mathcal{L} = \frac{1}{2}\Omega_{\alpha\beta}d\Omega^{\alpha\beta} + \frac{a_0}{3}\Omega_{\alpha}{}^{\beta}\Omega_{\beta}{}^{\gamma}\Omega_{\gamma}{}^{\alpha} \quad (9)$$

$$\delta\Omega^{\alpha\beta} = d\hat{\eta}^{\alpha\beta} + a_0\Omega^{(\alpha}{}_{\gamma}\hat{\eta}^{\beta)\gamma} \quad (10)$$

$$d\Omega^{\alpha\beta} + a_0\Omega^{\alpha}{}_{\gamma}\Omega^{\beta\gamma} = 0 \quad (11)$$

Thus we have a Chern-Simons gauge theory with the $Sp(2) \sim SO(2,1)$ group. Nice feature of such formulation beyond its simplicity is its background independence, while AdS_3 background appears just as a particular solution of equations. In the next two sections we will use the reverse procedure, namely we will start directly with such background independent formulation and then to see the field content we will go back to AdS_3 background.

3. $OSp(1,2)$ supergravity

As is well known [3] all (N, M) extended supergravities in AdS_3 can be considered as Chern-Simons theories with the supergroups $OSp(N, 2) \otimes OSp(M, 2)$. The simplest example is the $(1, 0)$ supergravity that contains just two massless fields: spin-2 and spin 3/2 ones. Here we reproduce this model to illustrate our formalism.

Model contains two one-form fields: spin-2 $\Omega^{\alpha\beta}$ and spin- $\frac{3}{2}$ Ψ^{α} ones. Let us consider the following ansatz for the Lagrangian

$$\begin{aligned} \mathcal{L} = & \frac{1}{2}\Omega_{\alpha\beta}d\Omega^{\alpha\beta} + \frac{i}{2}\Psi_{\alpha}d\Psi^{\alpha} \\ & + \frac{a_0}{3}\Omega_{\alpha}{}^{\beta}\Omega_{\beta}{}^{\gamma}\Omega_{\gamma}{}^{\alpha} + b_0\Psi_{\alpha}\Omega^{\alpha\beta}\Psi_{\beta} \end{aligned} \quad (12)$$

and corresponding gauge transformations:

$$\begin{aligned}\delta\Omega^{\alpha\beta} &= d\eta^{\alpha\beta} + \alpha_1\Omega^{\alpha}{}_{\gamma}\eta^{\beta\gamma} + \alpha_2\Psi^{\alpha}\xi^{\beta} \\ \delta\Psi^{\alpha} &= d\xi^{\alpha} + \alpha_3\eta^{\alpha\beta}\Psi_{\beta} + \alpha_4\Omega^{\alpha\beta}\xi_{\beta}\end{aligned}\tag{13}$$

Variations of the Lagrangian under the $\eta^{\alpha\beta}$ transformations have the form:

$$\begin{aligned}\delta_{\eta}\mathcal{L} &= 2(\alpha_1 - a_0)d\Omega_{\alpha\beta}\Omega^{\alpha}{}_{\gamma}\eta^{\beta\gamma} \\ &\quad + (i\alpha_3 + 2b_0)d\Psi_{\alpha}\eta^{\alpha\beta}\psi_{\beta} \\ &\quad + 2b_0(\alpha_3 - \alpha_1)\Psi_{\alpha}\Omega^{\alpha\beta}\eta_{\beta}{}^{\gamma}\Psi_{\gamma}\end{aligned}$$

so we have to put

$$\alpha_1 = \alpha_3 = a_0, \quad b_0 = -\frac{ia_0}{2}$$

At the same time variations under the ξ^{α} transformations look like:

$$\begin{aligned}\delta_{\xi}\mathcal{L} &= 2(\alpha_2 + b_0)d\Omega_{\alpha\beta}\Psi^{\alpha}\xi^{\beta} \\ &\quad + (i\alpha_4 - 2b_0)d\Psi_{\alpha}\Omega^{\alpha\beta}\xi_{\beta} \\ &\quad + 2(b_0\alpha_4 - a_0\alpha_2)\Psi_{\alpha}\Omega^{\alpha\beta}\Omega_{\beta}{}^{\gamma}\xi_{\gamma}\end{aligned}$$

so we obtain

$$\alpha_2 = \frac{ia_0}{2}, \quad \alpha_4 = -a_0$$

Thus all coefficients in the Lagrangian and gauge transformations are expressed in terms of just one coupling constant a_0 . Now let us consider equations that follow from this Lagrangian:

$$\begin{aligned}d\Omega^{\alpha\beta} + a_0\Omega^{\alpha}{}_{\gamma}\Omega^{\beta\gamma} + \frac{ia_0}{2}\Psi^{\alpha}\Psi^{\beta} &= 0 \\ d\Psi^{\alpha} + a_0\Omega^{\alpha}{}_{\beta}\Psi^{\beta} &= 0\end{aligned}\tag{14}$$

It is easy to see that AdS_3 background is a solution of these equations, namely:

$$\Omega_0^{\alpha\beta} = \frac{1}{a_0}\hat{\omega}_0^{\alpha\beta}, \quad \Psi_0^{\alpha} = 0$$

Again using $\Omega^{\alpha\beta} = \frac{1}{a_0}\hat{\omega}_0^{\alpha\beta} + \omega^{\alpha\beta}$ we obtain the Lagrangian for $(1,0)$ supergravity in AdS_3 background:

$$\mathcal{L} = \mathcal{L}_0 + \mathcal{L}_1$$

$$\begin{aligned}\mathcal{L}_0 &= \frac{1}{2}\omega_{\alpha\beta}D\omega^{\alpha\beta} + \frac{\lambda}{2}\omega_{\alpha\beta}e^{\alpha}{}_{\gamma}\omega^{\beta\gamma} \\ &\quad + \frac{i}{2}\Psi_{\alpha}D\Psi^{\alpha} + \frac{i\lambda}{4}\Psi_{\alpha}e^{\alpha}{}_{\beta}\Psi^{\beta}\end{aligned}\tag{15}$$

$$\mathcal{L}_1 = \frac{a_0}{3}\omega_{\alpha}{}^{\beta}\omega_{\beta}{}^{\gamma}\omega_{\gamma}{}^{\alpha} - \frac{ia_0}{2}\Psi_{\alpha}\omega^{\alpha\beta}\Psi_{\beta}\tag{16}$$

where \mathcal{L}_0 is just the sum of the free Lagrangians for massless spin-2 and spin- $\frac{3}{2}$ fields, while \mathcal{L}_1 describes self-interaction of graviton and its interaction with gravitino. Corresponding gauge transformations take the form:

$$\begin{aligned}\delta\omega^{\alpha\beta} &= D\eta^{\alpha\beta} + \frac{\lambda}{2}e^{(\alpha}{}_{\gamma}\eta^{\beta)\gamma} \\ &\quad + a_0\omega^{(\alpha}{}_{\gamma}\eta^{\beta)\gamma} + \frac{ia_0}{2}\Psi^{(\alpha}\xi^{\beta)} \\ \delta\Psi^{\alpha} &= D\xi^{\alpha} + \frac{\lambda}{2}e^{\alpha}{}_{\beta}\xi^{\beta} \\ &\quad + a_0\eta^{\alpha\beta}\Psi_{\beta} + a_0\omega^{\alpha}{}_{\beta}\xi^{\beta}\end{aligned}\tag{17}$$

4. $OSp(1,4)$ hypergravity

One of the important and peculiar features of three-dimensional higher spin theories is that corresponding infinite dimensional (super)algebras admit finite dimensional truncations [4]. For example, in [5] it was shown that consistent models containing massless fields with integer spins $2, 3, \dots, N$ can be considered as Chern-Simons theories with the gauge group $SL(N)$. Moreover, for even $N = 2n$ such models admit a truncation to the fields with even spins $2, 4, \dots, 2n$ only with corresponding group being $Sp(2n)$ [4, 6]. The simplest representative of these models is the one with group $Sp(4)$ containing just two fields with spin-2 and spin-4. But there exists a very well-known (but mostly in four dimensions) supergroup $OSp(1,4)$ that appears as the natural supersymmetric extension of the $Sp(4)$. Moreover, using a so-called principal embedding of $Sp(2)$ (see e.g. explicit expressions in Appendix A of [6]) it follows that corresponding model must contain fermionic field with spin $5/2$. Here we give a direct construction of such model.

We will use local $Sp(4)$ indices $a, b = 1, 2, 3, 4$ which will be raised and lowered with antisymmetric $Sp(4)$ invariant tensor E^{ab} normalized so that $E^{ab}E_{bc} = -\delta^a{}_c$. Then we introduce bosonic one-form Ω^{ab} and fermionic one-form Ψ^a . Note now that all calculations in the previous section demonstrating gauge invariance of the Lagrangian will not change if one will replace spinor indices α, β by a, b and $\varepsilon^{\alpha\beta}$ by E^{ab} . Thus we immediately obtain the Lagrangian

$$\begin{aligned}\mathcal{L} &= \frac{1}{2}\Omega_{ab}d\Omega^{ab} + \frac{i}{2}\Psi_a d\Psi^a \\ &\quad + \frac{\tilde{a}_0}{3}\Omega_a{}^b\Omega_b{}^c\Omega_c{}^a - \frac{i\tilde{a}_0}{2}\Psi_a\Omega^{ab}\Psi_b\end{aligned}\tag{18}$$

where $\tilde{a}_0 = \sqrt{10}a_0$ as well as corresponding gauge transformations:

$$\begin{aligned}\delta\Omega^{ab} &= d\eta^{ab} + \tilde{a}_0\Omega^{(a}{}_{c}\eta^{b)c} + \frac{i\tilde{a}_0}{2}\Psi^{(a}\xi^{b)} \\ \delta\Psi^a &= d\xi^a + \tilde{a}_0\eta^{ab}\Psi_b - \tilde{a}_0\Omega^{ab}\xi_b\end{aligned}\tag{19}$$

Equations for this Lagrangian look like:

$$\begin{aligned} d\Omega^{ab} + \tilde{a}_0 \Omega^a{}_c \Omega^{bc} + \frac{i\tilde{a}_0}{2} \Psi^a \Psi^b &= 0 \\ d\Psi^a + i\tilde{a}_0 \Omega^a{}_b \Psi^b &= 0 \end{aligned} \quad (20)$$

Now let us switch back to the multispinor formalism by the rule $a \Rightarrow (\alpha_1 \alpha_2 \alpha_3) = \alpha(3)$. Thus we introduce:

$$\begin{aligned} \Omega^{ab} &\Rightarrow \Omega^{(\alpha(3), \beta(3))} = \Sigma^{\alpha(3)\beta(3)} + \frac{1}{6\sqrt{10}} \varepsilon^{\alpha\beta} \varepsilon^{\alpha\beta} \Omega^{\alpha\beta} \\ \Psi^a &\Rightarrow \Psi^{\alpha(3)} \end{aligned}$$

where $\Sigma^{\alpha(6)}$ is completely symmetric six-spinor corresponding to spin-4 field, while two other fields correspond to spin-2 and spin- $\frac{5}{2}$. Here and in what follows the complete symmetrization over all spinor indices denoted by the same letter is assumed. Equations in terms of new variables take the form:

$$\begin{aligned} d\Omega^{\alpha\beta} + a_0 \Omega^\alpha{}_\gamma \Omega^{\beta\gamma} + 3a_0 \Sigma^\alpha{}_{\gamma(5)} \Sigma^{\beta\gamma(5)} + \frac{3ia_0}{2} \Psi^\alpha{}_{\gamma(2)} \Psi^{\beta\gamma(2)} &= 0 \\ d\Sigma^{\alpha(6)} + a_0 \Omega^\alpha{}_\beta \Sigma^{\alpha(5)\beta} + \frac{\tilde{a}_0}{2} \Sigma^{\alpha(3)}{}_{\beta(3)} \Sigma^{\alpha(3)\beta(3)} + \frac{i\tilde{a}_0}{20} \Psi^{\alpha(3)} \Psi^{\alpha(3)} &= 0 \\ d\Psi^{\alpha(3)} + a_0 \Omega^\alpha{}_\beta \Psi^{\alpha(2)\beta} + \tilde{a}_0 \Sigma^{\alpha(3)}{}_{\beta(3)} \Psi^{\beta(3)} &= 0 \end{aligned} \quad (21)$$

It is easy to see that we still have AdS_3 background as a solution

$$\Omega_0^{\alpha\beta} = \frac{1}{a_0} \hat{\omega}^{\alpha\beta}, \quad \Sigma_0^{\alpha(6)} = 0, \quad \Psi_0^{\alpha(3)} = 0$$

So for the AdS_3 background we obtain

$$\mathcal{L} = \mathcal{L}_0 + \mathcal{L}_{1b} + \mathcal{L}_{1f}$$

$$\begin{aligned} \mathcal{L}_0 &= \frac{1}{2} \omega_{\alpha\alpha} D\omega^{\alpha\alpha} + \frac{\lambda}{2} \omega_{\alpha\beta} e^\alpha{}_\gamma \omega^{\beta\gamma} \\ &\quad + \frac{1}{2} \Sigma_{\alpha(6)} D\Sigma^{\alpha(6)} + \frac{3\lambda}{2} \Sigma_{\alpha(5)\beta} e^\beta{}_\gamma \Sigma^{\alpha(5)\gamma} \\ &\quad + \frac{i}{2} \Psi_{\alpha(3)} D\Psi^{\alpha(3)} + \frac{3i\lambda}{4} \Psi_{\alpha(2)\beta} e^\beta{}_\gamma \Psi^{\alpha(2)\gamma} \end{aligned} \quad (22)$$

$$\begin{aligned} \mathcal{L}_{1b} &= \frac{a_0}{3} \omega_\alpha{}^\beta \omega_\beta{}^\gamma \omega_\gamma{}^\alpha + 3a_0 \Sigma_{\alpha(5)\beta} \omega^\beta{}_\gamma \Sigma^{\alpha(5)\gamma} \\ &\quad + \frac{10\tilde{a}_0}{3} \Sigma_{\alpha(3)\beta(3)} \Sigma^{\beta(3)}{}_{\gamma(3)} \Sigma^{\alpha(3)\gamma(3)} \end{aligned} \quad (23)$$

$$\mathcal{L}_{1f} = \frac{3ia_0}{2} \Psi_{\alpha(2)\beta} \omega^\beta{}_\gamma \Psi^{\alpha(2)\gamma} + \frac{3i\tilde{a}_0}{2} \Psi_{\alpha(3)} \Sigma^{\alpha(3)}{}_{\beta(3)} \Psi^{\beta(3)} \quad (24)$$

Here \mathcal{L}_0 is a sum of free Lagrangians for massless spin-2, spin-4 and spin- $\frac{5}{2}$ fields, \mathcal{L}_{1b} describes self-interaction for graviton, its interaction with spin-4 and self-interaction for spin-4 field, while \mathcal{L}_{1f} introduces gravitational interaction for spin- $\frac{5}{2}$ field and its interaction with spin-4. At the same time corresponding gauge transformations take the form:

$$\begin{aligned}
\delta\omega^{\alpha\alpha} &= D\eta^{\alpha\alpha} + \frac{\lambda}{2}e^\alpha{}_\beta\eta^{\alpha\beta} + a_0\omega^\alpha{}_\beta\eta^{\alpha\beta} \\
&\quad + 3a_0\Omega_{\beta(5)}{}^\alpha\eta^{\alpha\beta(5)} + \frac{3ia_0}{2}\Psi_{\beta(2)}{}^\alpha\xi^{\alpha\beta(2)} \\
\delta\Omega^{\alpha(6)} &= D\eta^{\alpha(6)} + \frac{\lambda}{2}e^\alpha{}_\beta\eta^{\alpha(5)\beta} \\
&\quad + a_0\Omega^{\alpha(5)}{}_\beta\eta^{\alpha\beta} + a_0\omega^\alpha{}_\beta\eta^{\alpha(5)\beta} \\
&\quad + \tilde{a}_0\Omega^{\alpha(3)}{}_{\beta(3)}\eta^{\alpha(3)\beta(3)} + \frac{i\tilde{a}_0}{20}\Psi^{\alpha(3)}\xi^{\alpha(3)} \\
\delta\Psi^{\alpha(3)} &= D\xi^{\alpha(3)} + \frac{\lambda}{2}e^\alpha{}_\beta\xi^{\alpha(2)\beta} \\
&\quad + a_0\Psi^{\alpha(2)}{}_\beta\eta^{\alpha\beta} + \tilde{a}_0\Psi_{\beta(3)}\eta^{\alpha(3)\beta(3)} \\
&\quad + a_0\omega^\alpha{}_\beta\xi^{\alpha(2)\beta} + \tilde{a}_0\Omega^{\alpha(3)}{}_{\beta(3)}\xi^{\beta(3)}
\end{aligned} \tag{25}$$

Note that there exists a straightforward generalization of this model to the case of $OSp(1, 2n)$ supergroup. Using again principal embedding (see e.g. Appendix C in [6]) we obtain model containing a number of bosonic fields with even spins $2, 4, \dots, 2n$ and one fermionic field with spin $n + 1/2$.

Conclusion

One of the important properties of three-dimensional higher spin theories is that there exist not only models with infinite number of higher spin fields as e.g. in [7, 8, 9], but also models with finite number of them, see e.g. [4, 5, 6, 10]. In this paper we have presented a whole class of models containing a number of bosonic fields with spins $2, 4, \dots, 2n$ and one fermionic field with spin $n + \frac{1}{2}$. As far as we know these are the simplest models containing fermions and as we have shown they can be considered as a straightforward generalization of the minimal $(1, 0)$ supergravity. Taking into account this similarity with the supergravity it may be tempting to try to construct some kind of matter hypermultiplets and consider their interaction with hypergravity. But the results of [4, 8] show that such a program is hardly possible. Certainly there have to exist similar generalization for extended supergravities but exploring this possibility lies beyond the scope of the current paper.

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